Using Cloud-to-Ground Lightning Climatologies to Initialize Gridded Lightning Threat Forecasts for East Central Florida

Winifred Lambert
ENSCO, Inc/Applied Meteorology Unit
321-853-8130 lambert.winnie@ensco.com
David Sharp, Scott Spratt, and Matthew Volkmer
National Weather Service, Melbourne, FL

Each morning, the forecasters at the National Weather Service in Melbourne, FL (NWS MLB) produce an experimental cloud-to-ground (CG) lightning threat index map for their county warning area (CWA) that is posted to their web site (http://www.srh.weather.gov/mlb/ghwo/lightning.shtml). Given the hazardous nature of lightning in central Florida, especially during the warm season months of May–September, these maps help users factor the threat of lightning, relative to their location, into their daily plans. The maps are color-coded in five levels from Very Low to Extreme, with threat level definitions based on the probability of lightning occurrence and the expected amount of CG activity. On a day in which thunderstorms are expected, there are typically two or more threat levels depicted spatially across the CWA. The locations of relative lightning threat maxima and minima often depend on the position and orientation of the low-level ridge axis, forecast propagation and interaction of sea/lake/outflow boundaries, expected evolution of moisture and stability fields, and other factors that can influence the spatial distribution of thunderstorms over the CWA.

The lightning threat index maps are issued for the 24-hour period beginning at 1200 UTC (0700 AM EST) each day with a grid resolution of 5 km x 5 km. Product preparation is performed on the AWIPS Graphical Forecast Editor (GFE), which is the standard NWS platform for graphical editing. Currently, the forecasters create each map manually, starting with a blank map. To improve efficiency of the forecast process, NWS MLB requested that the Applied Meteorology Unit (AMU) create gridded warm season lightning climatologies that could be used as first-guess inputs to initialize lightning threat index maps. The gridded values requested included CG strike densities and frequency of occurrence stratified by synoptic-scale flow regime. The intent is to increase consistency between forecasters while enabling them to focus on the mesoscale detail of the forecast, ultimately benefiting the end-users of the product.

Several studies took place at the Florida State University (FSU) and NWS Tallahassee (TAE) for which they created daily flow regimes using Florida 1200 UTC synoptic soundings and CG strike densities from National Lightning Detection Network (NLDN) data. The densities were created on a 2.5 km x 2.5 km grid for every hour of every day during the warm seasons in the years 1989–2004. The grids encompass an area that includes the entire state of Florida and adjacent Atlantic and Gulf of Mexico waters. Personnel at the two organizations provided this data and supporting software for the work performed by the AMU. The densities were first stratified by flow regime, then by time in 1-, 3-, 6-, 12-, and 24-hour increments while maintaining the 2.5 km x 2.5 km grid resolution. A CG frequency of occurrence was calculated for each stratification and grid box by counting the number of days with lightning and dividing by the total number of days in the data set. New CG strike densities were calculated for each stratification and grid box by summing the strike number values over all warm seasons, then normalized by dividing the summed values by the number of lightning days. This makes the densities conditional on whether lightning occurred. The frequency climatology values will be used by forecasters as proxy inputs for lightning probability, while the density climatology values will be used for CG amount. In addition to the benefits outlined above, these climatologies will provide improved temporal and spatial resolution, expansion of the lightning threat area to include adjacent coastal waters, and potential to extend the forecast to include the day-2 period.

This presentation will describe the lightning threat index map, discuss the work done to create the maps initialized with climatological guidance, and show examples of the climatological CG lightning densities and frequencies of occurrence based on flow regime.